PK-12 Stage One: Guiding Document

Content: Science

PK-12 Long-term Transfer Goal(s):

Long-term aims of the PK-12 program: An overall end result of a student's education in Madison.

Students will be able to independently use their learning to:

Make observations and ask questions to define a problem based on prior knowledge and curiosity that stimulates further exploration, analysis, and discovery.
Use the scientific process to generate evidence that addresses the original questions.
Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.
Evaluate scientific claims and analyze issues to verify the credibility of the source, data, and/or approach.
Communicate effectively based on purpose, task, and audience to promote collective understanding and/or recommend actions.

Stage One: Guiding Documents for Physical Science		
FORCES & MOTION NGSS Standards:	**Understandings:**	**Essential Questions:**
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **K-PS2-2.** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull. **3-PS2-1.** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **3-PS2-2.** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. **3-PS2-3.** Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. **3-PS2-4.** Define a simple design problem that can be solved by applying scientific ideas about magnets. **5-PS2-1.** Support an argument that the gravitational force exerted by Earth on objects is directed down.	• Pushes and pulls have different strengths and directions. • Electric and magnetic fields* act as forces on objects, even when not in contact directly. **Definition of FIELD: a field is a region in which each object is affected by a force.* • The pattern of an object's motion in various situations can be observed and measured from which predictions can be made. *(Example: pendulum)* • The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	• What makes an object move the way it does? • What happens when objects touch or collide? • What forces (push or pull) are acting on this object to make it move or stay still? • How can I describe and predict patterns of motion? • How can we prove that gravity exists when we can't see it? • What forces are acting on this object to make it move or stay still? • What effect does distance have on magnetic pull or push?

Stage One: Guiding Documents for Physical Science		
FORCES & MOTION NGSS Standards:	**Understandings:**	**Essential Questions:**
MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. **MS-PS2-2.** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. **MS-PS2-3.** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. **MS-PS2-4.** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. **MS-PS2-5.** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	• The motion of an object can be determined and/or predicted by using its position, velocity, and acceleration. • Objects in motion remain in straight-line motion at constant speed, and objects at rest remain at rest unless acted upon by unbalanced forces. (Newton's 1st law). • The acceleration of an object depends upon its mass and the net force acting on it. (Newton's 2nd Law) • Forces between objects come in pairs that are equal in magnitude but opposite in direction (Newton's 3rd law) • There is an attractive gravitational force between any two objects that is dependent on their masses and distance between them. • Electric and magnetic forces can be attractive or repulsive and are dependent on the strength of the charge or magnetic strengths and the distance between them.	• What makes an object move the way it does? • What forces (push or pull) are acting on this object to make it move or stay still? • How can I describe and predict patterns of motion? • How does gravity affect the motion of objects in the universe? • How is it possible for an object to stay in constant motion or constant rest forever? • How does an object's mass affect its motion? • How can you create forward motion? • Why do forces always come in pairs? • How do we see examples of the law of universal gravitation in our everyday lives? • How do you use simple machines to reduce the effort needed to do a job? • How do forces cause and affect motion?

Stage One: Guiding Documents for Physical Science		
FORCES & MOTION NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. **HS-PS2-2.** Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. **HS-PS2-3.** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. **HS-PS2-4.** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **HS-PS2-5.** Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. **HS-PS2-6.** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	• The acceleration of an object depends upon its mass and the net force acting on it. (Newton's 2nd Law) • Electric and magnetic forces can be attractive or repulsive and are dependent on the strength of the charge or magnetic strengths and the distance between them. • When two objects within a system the total momentum within the system is conserved. • Attractive and repulsive interactions at a distance (e.g., gravitational, magnetic, electrical and electromagnetic) can be described by using the concept of fields. • The motion of objects must be defined by using a frame of reference.	• What happens when objects collide? • How do the fundamental forces of the universe explain the behavior and interactions of objects? (e.g. particles, people, stars, planets) • How can an object be both moving, and not moving at the same time?

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ENERGY NGSS Standards:	**Understandings:**	**Essential Questions:**
K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface. **K-PS3-2.** Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area. **4-PS3-1.** Use evidence to construct an explanation relating the speed of an object to the energy of that object. **4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **4-PS3-3.** Ask questions and predict outcomes about the changes in energy that occur when objects collide. **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. **5-PS3-1.** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	• Energy can be transferred from place to place by sound waves, light waves, heat, and electric current *or* from object to object through collision. • The faster a given object is moving, the more energy it possesses. • Energy, in everyday life, typically refers to the conversion of stored energy into a desired form for practical use.	• How does the sun affect living things? What affect does the sun have on different surfaces? *(In K, focus here is how sun makes things warmer and how people can block sun.)* • What does energy look, feel, and sound like? • Why do faster objects have more kinetic energy? *(Example: bowling)* • How do I know energy converts from one form to another?
MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. **MS-PS3-2.** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. **MS-PS3-3.** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. **MS-PS3-4.** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic	• When the energy of one system changes, the energy of the other system must also change but the total energy must remain constant. • Each form of energy can be converted into other forms of energy or into work (e.g. kinetic to potential, mechanical to electrical). • The total thermal energy of a system depends on the total number of atoms, average temperature of each, and the state	• What does energy look, feel, and sound like? • Why do faster objects have more kinetic energy? *(Example: bowling)* • Where does the energy of a system come from? How does it change? Where does it go? • What happens to the motion of particles as they are heated and cooled? How does it impact their characteristics/appearance?

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ENERGY NGSS Standards:	**Understandings:**	**Essential Questions:**
energy of the particles as measured by the temperature of the sample.	of the material. • Energy can be described on a microscopic level which describes the motion/behavior of the particles.	• How can energy be used for different purposes?
HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. **HS-PS3-2.** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). **HS-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. **HS-PS3-4.** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	• Each form of energy can be converted into other forms of energy or into work (e.g. kinetic to potential, mechanical to electrical). • Energy can be described on a microscopic level which describes the motion/behavior of the particles. • While energy within a system is continually changing forms, and being transferred, the total energy of the system is conserved. • Uncontrolled systems always evolve to a more stable state (e.g. water flows downhill, objects hotter than their surroundings cool down) (2nd Law of Thermodynamics) (IS2: the release of energy in the evolution of a star and generation of power using geothermal systems, nuclear fission, and combustion of fossil fuels) • Energy that is stored in an electric, magnetic, or gravitational field depends upon the position of the objects in the field.	• Where does the energy of a system come from? How does it change? Where does it go? • How can the sun's energy be converted into more useful forms? • Why do some changes occur spontaneously? • How can position of an object in a field affect the amount of energy it has stored?

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SOUND & LIGHT WAVES AND ELECTROMAGNETIC RADIATION NGSS Standards:	**Understandings:**	**Essential Questions:**
1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. **1-PS4-2.** Make observations to construct an evidence-based account that objects can be seen only when illuminated. **1-PS4-3.** Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. **1-PS4-4.** Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. **4-PS4-1.** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. **4-PS4-2.** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. **4-PS4-3.** Generate and compare multiple solutions that use patterns to transfer information. **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	• Sound can make matter vibrate, and vibrating matter can make sound. • People use light and sound to communicate. • Waves can be observed as patterns of motion and measured *(frequency, amplitude, and wavelength)* from which predictions can be made. • Waves of the same type can differ in amplitude (sound) and wavelength (sound and light) • Digitized information (data) can be transmitted over long distances. • An object can be seen when light is reflected from its surface enters the eyes.	• How is sound created? How does it travel? • How does light help me? • Why do we see shadows in some places and not in others? • How do I communicate without words or pictures? (Examples of devices could include a light source to send signals, paper cup and string telephones, and a pattern of drum beats.) • How do I describe a given wave? • How does information travel over long distances? • How do we see things? • How do I communicate using light and sound? • How do waves carry information over long distances? • What is the relationship between the volume of a sound and its energy?
MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	• Some waves (sound) require a medium to travel through. Other waves (light or	• How is sound created? How does it travel?

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SOUND & LIGHT WAVES AND ELECTROMAGNETIC RADIATION NGSS Standards:	**Understandings:**	**Essential Questions:**
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. **MS-PS2-3.** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. **MS-PS2-4.** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. **MS-PS2-5.** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	electromagnetic) do not require a medium. • Wavelength, frequency, and amplitude are properties of a wave that determine its characteristics such as pitch, color, sound and energy. • When light shines on an object, it is reflected, absorbed, or transmitted (refracted) through the object, depending on the object's material and the frequency (color) of the light. • Light travels in straight lines unless it travels through different mediums. • A wave model of light is useful for explaining brightness, color and refraction. • Information can be converted into a digital form so that it can be stored or transmitted through waves.	• How does light help me? • Why do we see shadows in some places and not in others? • How do I communicate without words or pictures? (Examples of devices could include a light source to send signals, paper cup and string telephones, and a pattern of drum beats.) • How would we use waves to explain what we see and hear in the world around us? • How does information travel over long distances? • How do waves travel? • How are wave properties evident in everyday life? • How does light interact with objects/ what happens when light hits an object? How do objects affect how we see light? • Why are there different colors of light? Why do we see different colors? • How are waves used to transfer energy and transmit information? • How do we see? • What affect do lenses have on light and the images we see? • How do different surfaces affect light and what we see? • What does the electromagnetic spectrum tell us about light? • How are different frequencies used for

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SOUND & LIGHT WAVES AND ELECTROMAGNETIC RADIATION NGSS Standards:	**Understandings:**	**Essential Questions:**
		different purposes? • How can light affect temperature? • How can we change light to be used for different purposes? • How is information represented or stored digitally or in digital devices?
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. **HS-PS4-2.** Evaluate questions about the advantages of using a digital transmission and storage of information. **HS-PS2-3.** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. **HS-PS2-4.** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **HS-PS4-5.** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. **HS-PS2-6.** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	• Wavelength, frequency, and amplitude are properties of a wave that determine its characteristics such as pitch, color, sound and energy. • Information can be converted into a digital form so that it can be stored or transmitted through waves. • When waves encounter objects they can reflect, refract, diffract or absorb depending on the property of material. • Two or more waves that occupy the same space at the same time may interfere constructively or destructively. • Electromagnetic radiation can be represented by oscillating magnetic and electric fields (waves) or as photons (particles). • Frequency of electromagnetic waves is directly proportional to its energy which can affect how it interacts with matter. • Waves are used in scientific applications and everyday purposes.	• Why are multiple models of light needed to explain its behavior? • Why are different forms of radiation used for different purposes? • How are waves beneficial?

Stage One: Guiding Documents for Physical Science		
MATTER AND ITS INTERACTIONS NGSS Standards:	**Understandings:**	**Essential Questions:**
2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. **2-PS1-2.** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. **2-PS1-3.** Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. **2-PS1-4.** Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. **5-PS1-1.** Develop a model to describe that matter is made of particles too small to be seen. **5-PS1-2.** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **5-PS1-3.** Make observations and measurements to identify materials based on their properties. **5-PS1-4.** Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	• Everything is made of matter. • Different kinds of matter exist and many of them can be either solid or liquid, depending on the temperature. Matter can be described by its observable properties. • Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. • Matter of any type can be subdivided into particles that are too small to see. • When a change in matter occurs, the total mass remains the same (conservation). • In a chemical reaction, the particles that make up the original substances can be regrouped into different substances. These new substances may have different properties than the original substances.	• How are liquids different from solids? • How do we know gases exist? • How does changing the temperature affect an object? • When an object changes, can it be changed back? • What does matter look like?(NOTE in MS we transition to the microscopic via atoms and molecules but using same question) • What happens to the mass of substances when they change form or react? • What happens to the particles in a chemical reaction? • How can we describe the motion of particles in different states of matter?
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. **MS-PS1-2.** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	• Matter is made up of different types of atoms which can combine to form molecules. (In MS discussions are not to include types of bonds or valence electrons.) • Substances can be identified by their	• How do we know gases exist? • How does changing the temperature affect an object? • When an object changes, can it be changed back? • What does matter look like?(NOTE in MS we

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MATTER AND ITS INTERACTIONS NGSS Standards:	**Understandings:**	**Essential Questions:**
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. **MS-PS1-4.** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. **MS-PS1-5.** Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. **MS-PS1-6.** Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	physical and chemical properties. • Molecules in solids, liquids, and gases are in constant motion. In solids, particles vibrate in place. In liquids, particles slide past each other but remain close together. In gases, particles have random motion and are far apart. • Changes in temperature and pressure can cause a change in state. • In a chemical reaction atoms can be rearranged and new substances with new properties are created. • Chemical reactions can absorb or release thermal energy. • Temperature is not a direct measure of a system's total thermal energy. Temperature is a measure of the average kinetic energy of particles of matter. Heat refers to the energy transfer of two objects at different temperatures.	transition to the microscopic via atoms and molecules but using same question) • What happens to the mass of substances when they change form or react? • How can we describe the motion of particles in different states of matter? • What does it mean to melt? To boil? To freeze? • What happens to the atoms in a chemical reaction? • What makes an object feel hot or cold? • What are the characteristics of different forms of matter? • How do we describe and classify matter? • How can knowing the physical/chemical properties of matter be useful? • What are some properties of acids and bases? • What is pH and how does it measure the concentration of acids and bases? • Why are elements and compounds classified as pure substances? • How do mixtures differ from pure substances? • How can mixtures be separated? • How can you tell if a chemical change has occurred? • How can we explain the processes of phase change in terms of temperature, heat transfer, and particle arrangement? • What is the structure of the atom and how do

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MATTER AND ITS INTERACTIONS NGSS Standards:	**Understandings:**	**Essential Questions:**
		we know? • What happens to electrons when atoms gain or lose energy? • How does the composition of an element determine its placement on the periodic table?
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. **HS-PS1-2.** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. **HS-PS1-3.** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. **HS-PS1-4.** Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. **HS-PS1-5.** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. **HS-PS1-6.** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. **HS-PS1-7.** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	• Atoms are comprised of subatomic particles held together by fundamental forces and their quantity and arrangement determines the atom's properties, identity, and behavior. • The organization of elements in the periodic table based on atomic structure facilitates predictions about their characteristics? • The structure and interactions of matter are determined by electrical forces within and between atoms. • Chemical processes, their rates, and corresponding energy changes can be understood in terms of the collisions of molecules and the rearrangement of atoms as bonds break and form to create new molecules. • In many situations a dynamic balance exists between a reaction and the reverse reaction which determines the numbers of all types of molecules present.	• How does understanding the organization of the periodic table allow scientists to make predictions? • What information do you need to predict the property of an element? • How do different substances interact? • What happens to atoms and energy in a chemical reaction? • How could you increase the amount of products present at equilibrium? • How can you demonstrate that atoms are conserved during a chemical reaction? • What is the difference between a nuclear reaction and a chemical reaction? • How are elements arranged on the periodic table? • Why do the elements in a group have similar chemical properties? • How does knowing trends on the periodic table help scientists predict properties of elements? • Why do elements form bonds? • How can you predict the type of bond that will form between two elements? • How can you predict the product of a chemical reaction?

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MATTER AND ITS INTERACTIONS NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	• The fact that atoms are conserved can be used to describe and predict chemical reactions. • Nuclear processes involve release or absorption of energy and changes to the numbers and type of particles in the nucleus.	• Why is carbon considered the basic building block of life? • Why are hydrocarbons used as fuels (fossil fuels)? • How does the structure of polymers dictate their properties?

Stage One: Guiding Documents for Life Science		
STRUCTURES AND PROCESSES NGSS Standards:	**Understandings:**	**Essential Questions:**
K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. **1-LS1-1.** Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. **1-LS1-2.** Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. **3-LS1-1.** Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. **4-LS1-1.** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **4-LS1-2.** Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. **5-LS1-1.** Support an argument that plants get the materials they need for growth chiefly from air and water.	● All living things have basic needs in order to survive and grow. ● All living things have different structures and behaviors that help them survive, grow, and meet their needs. ● All living things have unique life cycles which include birth, growth, reproduction, and lifespan.	• What does this _____ (living thing) need to survive and grow? • How do the different parts of a living thing help it survive? • How do organisms use their senses to survive? • What do "babies" do to get their parents attention? How do parents help them? • How do the life cycles of this _____ and this_____ (living things) compare to one another?
MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. **MS-LS1-2.** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. **MS-LS1-3.** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	● Cells have organelles and other structures that help them survive, grow, and meet their needs. ● In multicellular organisms cells work together in groups to form tissues and organs with specific functions. ● Animals engage in behaviors that increase	● How do the different parts of a cell help it survive? ● How do cells/systems group together to perform a particular body function? ● How can an animal increase its odds of reproduction?

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STRUCTURES AND PROCESSES NGSS Standards:	**Understandings:**	**Essential Questions:**
MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. **MS-LS1-5.** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **MS-LS1-6.** Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. **MS-LS1-7.** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. **MS-LS1-8.** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	the odds of reproduction. ● Animal and plant growth is affected by both genetic and environmental factors. ● Plants use the energy from light to make sugars (food) through photosynthesis. ● Within every organism, food is broken down through a series of chemical reactions that release energy. ● Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	● How do genetic and environmental factors affect the growth of animals and plants? ● How does the process of photosynthesis provide for the energy demands of plants? ● How do all organisms rely on photosynthesis for their own survival? ● How do organisms receive, process, and respond to sensory information? ● Why are the basic anatomical structures of the human respiratory, circulatory, and excretory system so vital? ● How do the organ systems bring oxygen and nutrients to the cells and expel wastes?
HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. **HS-LS1-2.** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **HS-LS1-3.** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. **HS-LS1-4.** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	● Systems of specialized cells within organisms help perform essential functions of life. ● Multicellular organisms have a hierarchical structural organization in which any one system in an organism is made up of numerous parts. ● Feedback mechanisms maintain an organism's internal conditions (homeostasis) within certain limits and allows them to	● How are cells organized and how do they work together in a multicellular organism? ● How do feedback mechanisms help organisms respond to changing environments? ● How do mitosis and cell differentiation enable organismal growth and development? ● How are the processes of photosynthesis

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STRUCTURES AND PROCESSES NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. **HS-LS1-6.** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. **HS-LS1-7.** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	survive as conditions change. ● Cellular growth, division (mitosis), and differentiation produce and maintain a complex organism. ● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide and water into sugars and released oxygen. ● The sugar molecules formed by photosynthesis provide carbon, hydrogen, and oxygen atoms used to make all other carbon based molecules (DNA, proteins, etc.) ● All organisms carry out cell respiration which breaks down sugar with the help of oxygen to create a usable form of chemical energy.	and cell respiration connected in the cycling of matter and transfer of energy? *Note: we would want them to trace energy back to the Sun, through photosynthesis (producers) into chemical energy of food and ultimately through cell respiration (all organisms) into chemical energy of ATP.* ● How are the products of photosynthesis related to the creation of carbon based molecules (DNA, proteins, etc.) necessary for life? ● Why is the process of cell respiration vital to all organisms?

Stage One: Guiding Documents for Life Science		
HEREDITY NGSS Standards:	**Understandings:**	**Essential Questions:**
1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. **3-LS3-1.** Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. **3-LS3-2.** Use evidence to support the explanation that traits can be influenced by the environment.	● Young plants and animals are similar to, but not exactly like, their parents. ● The characteristics of living things are influenced by inheritance and environment.	● How are young plants and animals similar to their parents? How are they different? ● What does an offspring inherit from their parents? ● How does the environment affect an organism's characteristics? ● How do organisms use internal and external structures and their senses to survive?
MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. **MS-LS3-2.** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	● Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. ● Organisms inherit chromosomes from their parents containing genes that code for different proteins which affect an individual's traits. ● In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. ● Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to the proteins and traits of an organism.	● What are the similarities and differences between sexual and asexual reproduction? ● How are genes, proteins, and traits related? ● How does sexual reproduction lead to variation between parents and offspring? ● What impact can mutations have on living things?
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions	● Although each cell has the same genetic information, each cell can vary in structure	● How can cells function differently when they have the same genetic information?

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HEREDITY NGSS Standards:	**Understandings:**	**Essential Questions:**
for characteristic traits passed from parents to offspring. **HS-LS3-2.** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. **HS-LS3-3.** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	and function because different genes are expressed. ● The variation and distribution of traits in a population depend on genetic and environmental factors. ● Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.	● How do genetic and environmental factors introduce new traits in organisms?

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ECOSYSTEMS NGSS Standards:	Understandings:	Essential Questions:
2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow. **2-LS2-2.** Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. **3-LS2-1.** Construct an argument that some animals form groups that help members survive. **5-LS2-1.** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	● Organisms depend on things in their environment for their own growth, reproduction, and survival. ● If the characteristics of an ecosystem change, some organisms survive, some move to new locations, and some die. ● Matter cycles between the living and non-living parts of an ecosystem. ● Living in groups helps many animals survive.	● What do plants need to survive and grow? ● How do animals help plants make more plants? ● What are the relationships between organisms in a food web? ● What impact do various factors have on the balance of a healthy ecosystem? ● How does matter cycle between air, soil, and living things in a healthy ecosystem? ● How does being a member of a group benefit an animal? ● How do the characteristics of the _____ (biome) affect _____'s ability to survive there? ● How do the life cycles of this _____ and this _____ (similar species) compare to one another (in two different biomes)? ● How do our actions and choices impact the world around us?
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **MS-LS2-2.** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. **MS-LS2-3.** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. **MS-LS2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	● Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. ● Competitive, predatory, and mutually beneficial interactions vary across ecosystems but patterns are shared. ● The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.	● How do interactions between living and nonliving things impact populations and communities? ● How do behaviors (competitive, predatory, etc.) between living things contribute to survival? ● What are the similarities and differences between these behaviors in different ecosystems? (Focus on shared patterns of behavior)

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ECOSYSTEMS NGSS Standards:	**Understandings:**	**Essential Questions:**
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	● Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem. ● Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. ● The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. ● Changes in biodiversity can impact humans' resources.	● How does an atom of _____ cycle through the living and nonliving parts of an ecosystem? ● How does matter and energy transfer through the different levels of a food web in an ecosystem? ● What is the impact (both positive and negative) on populations due to various ecological disruptions? ● How does biodiversity contribute to the health and stability of an ecosystem? ● In what ways are humans impacted by changes in biodiversity? ● What impact do various factors have on the balance of a healthy ecosystem?
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. **HS-LS2-2.** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. **HS-LS2-3.** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. **HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	● Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. ● Photosynthesis and cellular respiration provide most of the energy for life processes. ● Only a fraction of the energy consumed at the lower trophic levels of a food web is transferred up, resulting in fewer organisms	● How do environmental factors (biotic and abiotic) affect the carrying capacity of different populations within a given ecosystem? ● How do the processes of photosynthesis and cellular respiration provide most of the energy in an ecosystem? ● Why are populations smaller for organisms near the top of the trophic structure?

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ECOSYSTEMS NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. **HS-LS2-6.** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. **HS-LS2-8.** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	at higher levels. ● Photosynthesis and cellular respiration are key components of the global carbon cycle. ● If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem. ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	● How are the processes of photosynthesis and cell respiration connected in the cycling of carbon? ● What is the impact (both positive and negative) on populations due to various ecological disruptions? ● How are ecosystems impacted by human activity? ● How does group behavior enhance the chances of survival for organisms?

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BIOLOGICAL EVOLUTION NGSS Standards:	**Understandings:**	**Essential Questions:**
2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. **3-LS4-1.** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **3-LS4-2.** Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. **3-LS4-3.** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. **3-LS4-4.** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.	● The characteristics of an ecosystem determine the types and diversity of plants and animals that live there. ● If the characteristics of an ecosystem change, some organisms survive, some move to new locations, and some die. ● Differences in characteristics between individuals of the same species, in any environment, provide advantages in surviving, finding mates, and reproducing. ● Fossils provide evidence about the types of extinct organisms that lived long ago and also about the environments in which they lived.	● How does an ecosystem support the plants and animals that live there? (Gr. 2) ● How does the _____'s traits help it survive in a _____ ecosystem? (Gr. 2) ● How do organisms respond to changes in their ecosystem? (Gr. 3) ● What makes one _____ (member of species) more likely to survive and/or reproduce, than another _____ (member of same species)? (Gr. 3) ● What can we learn from fossils? (Gr. 3)
MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. **MS-LS4-2.** Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. **MS-LS4-3.** Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. **MS-LS4-4.** Construct an explanation based on evidence	● The fossil record chronologically documents the existence, diversity, evolution, and extinction of many life forms and their environments through Earth's history. ● The fossil record and comparisons of anatomical similarities between organisms suggests lines of evolutionary descent. ● Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed adult anatomy.	● How can fossils be used to interpret the changes in organisms and their environment over time? (cover age determination, emergence, evolution, and extinction) ● What can anatomical similarities between organisms tell us about their evolutionary relationships? ● What evidence of common ancestry do embryos reveal that cannot be seen in adult form? ● How does the process of natural selection

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BIOLOGICAL EVOLUTION NGSS Standards:	**Understandings:**	**Essential Questions:**
that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. **MS-LS4-5.** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. **MS-LS4-6.** Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	● Natural and artificial selection results from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain genetic traits in a population. ● Species can change over time in response to changes in environmental conditions through natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.	explain the evolution of a species over time? ● How do humans manipulate characteristics of organisms? What is the impact?
HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. **HS-LS4-2.** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. **HS-LS4-3.** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. **HS-LS4-4.** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. **HS-LS4-5.** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1)	● Evolutionary lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms. ● Natural selection occurs only if there is variation in the genes and associated traits between individuals in a population. Traits that positively affect survival can become more common in a population. ● Evolution results primarily from natural selection: genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. ● Natural selection leads to organisms with	● How do scientists use evidence to identify common ancestry in present day organisms? ● How does natural selection act on genes in order to promote species survival? ● How does the process of natural selection explain the evolution of a species over time? ● Why do organisms seem to be so adapted to the places that they live? What happens when their environment changes? ● How does the development of new species and loss of species influence evolution of life on Earth?

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BIOLOGICAL EVOLUTION NGSS Standards:	**Understandings:**	**Essential Questions:**
increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. **HS-LS4-6.** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	adaptations (anatomical, behavioral, and physiological) that are well suited to survival and reproduction in a particular environment. ● The distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change. ● Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction)	

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EARTH's SYSTEM NGSS Standards:	Understandings:	Essential Questions:
K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time. **K-ESS2-2.** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **2-ESS2-1.** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. **2-ESS2-2.** Develop a model to represent the shapes and kinds of land and bodies of water in an area. **2-ESS2-3.** Obtain information to identify where water is found on Earth and that it can be solid or liquid. **3-ESS2-1.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. **3-ESS2-2.** Obtain and combine information to describe climates in different regions of the world. **4-ESS2-1.** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. **4-ESS2-2.** Analyze and interpret data from maps to describe patterns of Earth's features. **5-ESS2-1.** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. **5-ESS2-2.** Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	● Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. ● Things that people do to live comfortably can affect the world around them. ● Wind and water (in varying forms) can change the shape of the land. ● Scientists record patterns and make predictions of the weather across different times and areas. ● Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time. ● Water, ice, wind, living organisms, and gravity break Earth's materials into smaller particles altering its landscape. ● The variations of earth's features extends from the bottom of the ocean to the tops of mountains (mountain ranges, trenches, etc) and occur in patterns. ● Earth's major systems interact in multiple ways to affect Earth's surface materials and processes. ● Most of the earth's surface is covered by	● How do I describe today's weather? ● What will the weather be like tomorrow/next week? ● Can you predict the weather? ● How does the weather help me make decisions? ● What kinds of choices do people make to live comfortably? ● How does wind and water change the shape of the land? ● How can I use maps to show change in the earth's surface? ● How does looking at patterns of weather tell me about the climate of a region? ● What types of severe weather are most common in a given region? ● What is the job of a weather forecaster? ● How can you prepare for severe weather? ● How do living things affect the world around them? ● How does looking at patterns of weather determine the climate of a region? ● How can we record weather patterns? ● What's under the ocean? ● How is earth's surface below the ocean the same as on land? ● Do maps show land and water features on the earth's surface? ● How do earth's systems interact? ● What is typical weather in different parts of the world and during different times of the year? ● How does Earth change quickly and

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EARTH's SYSTEM NGSS Standards:	**Understandings:**	**Essential Questions:**
	water in various forms (vapor, oceans, streams, glaciers, etc.)	slowly? (volcanic eruptions, earthquakes and erosion) ● What helps shape the land? How does the land change over time? ● How does the water cycle through Earth's spheres?
MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. **MS-ESS2-2.** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. **MS-ESS2-3.** Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. **MS-ESS2-4.** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. **MS-ESS2-5.** Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. **MS-ESS2-6.** Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	● Tectonic processes continually shape the earth's surface. ● All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. ● The interactions of the planet's systems have shaped Earth's history and will determine its future. ● Weather patterns are the result of the variations on the earth's surface and in the atmosphere.	● How does the earth's surface move? ● Where does the earth's energy come from and how does it flow? ● Why do weather patterns change? (Locally, regionally and globally) ● How can we prove that gravity exists in the solar system when we can't see it? ● How do you predict weather? ● How can the boundaries of tectonic plates be inferred from the location of earthquakes and volcanoes? ● Why do all the planets orbit in the same plane?
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. **HS-ESS2-2.** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems	● Cyclical changes in the shape of Earth's orbit around the sun, over hundreds of thousands of years, causes periods of gradual climate change. ● The Earth's major systems interact in multiple ways to affect the earth's surface	● How do scientists observe, record, study and predict changes in the earth? ● How do changes in the variations in the flow of energy into and out of the earth's system influence climate?

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EARTH's SYSTEM NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. **HS-ESS2-4.** Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. **HS-ESS2-5.** Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. **HS-ESS2-6.** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. **HS-ESS2-7.** Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	materials and processes. ● Earth's interior is dynamic and results in the cycling of matter from the surface. ● Earth's climate is the result of sudden and long term interactions of its orbital relationship with the sun, internal tectonic forces, and features at Earth's surface. ● Earth continually generates internal energy that helps drive plate movements. ● Plate tectonics is the unifying theory that explains the past and current movements responsible for features found on land and the floor of oceans. ● The abundance of water and its unique properties help to shape the Earth's surface. ● The foundation for Earth's global climate systems is a combination of electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. ● Living and nonliving processes change the composition of the atmosphere over time thus affecting climate and living conditions.	● How does the land change? What are some factors that cause it to change? ● What do seismic waves tell you about the interior of the earth? ● Why does water play such an important role in the characteristics and behavior of Earth's major systems? ● How do maps help us understand the present and past location of geological features? ● What factors interact and influence weather and climate? ● How does the study of weather and climate influence human behavior? ● How does one change in the earth's system cause changes in other earth systems? ● Why does Earth generate a magnetic field?

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EARTH's SYSTEM NGSS Standards:	**Understandings:**	**Essential Questions:**
	● Global climate are the result of the variations on the earth's surface and in the atmosphere.	

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EARTH & HUMAN ACTIVITY NGSS Standards:	**Understandings:**	**Essential Questions:**
K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. **K-ESS3-2.** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. **K-ESS3-3.** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. **3-ESS3-1.** Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. **4-ESS3-1.** Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. **4-ESS3-2.** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. **5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	● Living things need water, air, and resources from the land, and they live in places that have the things they need. ● Humans use natural resources for everything they do. ● Some kinds of severe weather are more likely than others in a given region. ● Things that people do to live comfortably can affect the world around them. ● The history of natural hazards can help forecast geological events (earthquakes, tsunamis, volcanic eruptions). ● Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. ● Human activities have had a global effect on the land, vegetation, streams, ocean, air, and even outer space.	● How do people's actions affect the world around them in a positive or negative way? ● What do I need from the earth to live? ● What natural resource(s) does my family use? ● What makes the car go? ● How does my family keep the house warm in the winter? ● How does my family keep the house cool in the summer? ● How can people prepare for natural disasters? ● Can all resources be reused? ● What types of resources do you and your family use? ● How does the use of energy and fuels change or affect the environment? ● How are people trying to preserve the Earth's resources and protect the environment? ● How can we manage human behavior to

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EARTH & HUMAN ACTIVITY NGSS Standards:	**Understandings:**	**Essential Questions:**
		help protect the earth? ● What do people do that waste resources? How can we make it better? ● How can we prevent or slow the effects of erosion or weathering? ● What can we learn from fossils? ● What types of natural disasters are most common in a given region and how can we reduce their impact?
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. **MS-ESS3-2.** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. **MS-ESS3-4.** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. **MS-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	● Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources ● Human activities significantly alter natural habitats, causing changes to Earth's environment that can impact living things.	● Are Earth's resources limited? ● In what ways can Earth's resources be managed? ● In what ways are living things including humans vulnerable to changes in Earth's climate? ● What activities done by humans impact the environment? ● Will the growth in human population negatively impact the environment? ● How might human activity impact water resources in Connecticut such as ponds, rivers, and the Long Island Sound?

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EARTH & HUMAN ACTIVITY NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. **HS-ESS3-2.** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. **HS-ESS3-3.** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. **HS-ESS3-5.** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. **HS-ESS3-6.** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	● Human society is dependent on the availability of resources. ● Natural hazards and other geologic events have shaped the course of human history. ● The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● The magnitudes of human impacts are greater than they have ever been. ● Important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact.	● What resources do we depend on? ● How are resources obtained? ● Are there consequences to obtaining resources from the environment? ● How does climate influence migration of human populations? ● In what ways do engineers contribute to the sustainability of biodiversity? ● Has humanity learned all it can about how the Earth's systems interact? ● How have known human activities modified the ocean, atmosphere, geosphere, and biosphere?

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EARTH's PLACE IN UNIVERSE NGSS Standards:	**Understandings:**	**Essential Questions:**
1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted. **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year. **2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **4-ESS1-1.** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. **5-ESS1-1.** Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. **5-ESS1-2.** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	● Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. Using models . ● Seasonal patterns of sunrise and sunset can be observed, described, and predicted ● Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. ● Rock formations reveal changes and patterns over time due to earth's forces. ● Stars range greatly in their distance from the earth. ● The orbit of the earth and the moon have observable patterns.	● What patterns do I see in the sky? ● How can I describe the patterns? ● How can I describe patterns using models? ● How are patterns the same/different everyday? ● What events cause the Earth to change quickly and slowly (volcanic explosions, earthquakes, erosion)? ● How can you determine how old a rock layer is? ● How do maps help me understand the Earth? ● Why do stars vary in appearance from earth? ● Why can't we see stars while the sun is out? ● What can rocks tell us about the history of the earth's surface?
MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. **MS-ESS1-2.** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	● All objects, including galaxies in the universe, are shaped by the force of gravity. ● The solar system is held in orbit around the sun by its gravitational pull on them.	● Why is the earth round? ● Why don't eclipses happen in the same time and place every year? ● What holds the solar system together? Why

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EARTH's PLACE IN UNIVERSE NGSS Standards:	**Understandings:**	**Essential Questions:**
MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system. **MS-ESS1-4.** Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.	● The model of our solar system can explain phenomena such as eclipses and the Earth's seasons. ● Varying intensities of sunlight across the surface of the earth causes the seasons. ● The geologic time scale is interpreted from the analyses of rock strata and the fossil record.	do the look the way they look? Why do they move the way they do? ● What would the seasons look like if there was no tilt? ● How do the intensities of the seasons in the southern hemisphere compare to the seasons in the northern hemisphere? ● How are rocks and fossils dated? ● Why don't eclipses happen in the same time and place every year? ● Why can't we see stars while the sun is out? ● How does planet Earth function within the solar system?
HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. **HS-ESS1-2.** Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. **HS-ESS1-3.** Communicate scientific ideas about the way stars, over their life cycle, produce elements. **HS-ESS1-4.** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	● The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. ● The origin of the universe is supported by observations of distant galaxies and the composition of stars. ● Information about Earth's formation and early history can be discovered by observing other objects in the solar system, which have changed little over billions of years.	● What does the light from a star tell us? ● What is light? ● How is light emitted by matter? ● How do people reconstruct earth's planetary history? ● How does the earth receive energy? ● How do stars change the chemical composition of our universe?

Stage One: Guiding Documents for Earth & Space Science		
EARTH's PLACE IN UNIVERSE NGSS Standards:	**Understandings:**	**Essential Questions:**
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. **HS-ESS1-6.** Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	● Nuclear Fusion processes in the sun release the energy that ultimately reaches Earth as radiation.	